

PTO 05-958

Russian Federation Patent
No. 2 130 958 C1

ANTI-ICING AGENT AND METHOD OF PREPARING THEREOF

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UNITED STATES PATENT AND TRADEMARK OFFICE
WASHINGTON, D.C. DECEMBER 2004
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RUSSIAN FEDERATION
AGENCY FOR PATENTS AND TRADEMARKS
PATENT NO. RU 2 130 958 C1

Int. Cl.⁶: C 09 K 3/18, B 01 J 2/02
Filing No.: 97118561/04
Filing Date: November 6, 1997
Publication Date: May 27, 1999

ANTI-ICING AGENT AND METHOD OF PREPARING THEREOF

[Antigololodednyi reagent I sposob ego polucheniya]

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References Cited: SU 306162 A, July 23, 1971
SU 1087547 A, April 23, 1984
US 4512907 A, August 18, 1987
US 4698173 A, October 6, 1987
EP 375214 A1, June 27, 1990

The invention relates to compositions that are used to prevent or remove ice formations from snow- or ice-covered surfaces.

Anti-icing reagents are used to prevent the formation of ice and also to destroy ice that has already formed. Widely known in the capacity of such reagents are inorganic salts such as sodium, magnesium and calcium chlorides, potassium, sodium and ammonium phosphates, nitrates of alkaline earth metals, alkali metal sulfates, and also organic compounds such as low-molecular alcohols, glycols, glycerol, and carboxylates.

Particular importance is given to the corrosive effects of these reagents on structures containing metal and on the environment. It is well known that inorganic salts are the most commonly used because they are cheap: sodium, calcium and magnesium chlorides: the chlorine in these reagents not only breaks up ice, but also causes significant corrosion to metal structures

(the corrosion rate of steel St3 in CaCl_2 solutions is as high as 0.65 mm/yr; the corrosion is of pitting type). The harmful effect of sodium chloride on the environment is manifested in the accumulation of chlorine ions in the roadside, which leads to contamination of ground water, including underground water supply sources, contributing to wind and water erosion of soils, damage and destruction of roadside vegetation.

Corrosion is reduced when organic anti-icing reagents are used, but it still remains significant. In addition, an economic problem comes up because of the high losses of the reagent due to its volatility, and there is also the problem of protection of the environment.

Agents that use less corrosive and more ecologically safe compounds like urea and nitrates of alkali and alkaline earth metals are coming into use.

There is a known anti-icing agent that contains calcium nitrate and urea. A shortcoming of it is an elevated tendency to cake during storage and insufficient corrosion stability [TU [Technical Specifications] 6-03-362-86].

There is a known anti-icing composition that contains calcium nitrate and urea that is distinguished by the fact that a urea-crotonic acid polymer has been added to it to reduce hygroscopicity and cakeability [SU 306162].

Its shortcoming is its high corrosivity toward metals.

A basic task, the solution of which is the aim of the invention, is to obtain a corrosion-safe and non-caking agent for the removal/prevention of ice formations on road surfaces, sidewalks, and other surfaces that is based on calcium nitrate and urea.

This result is achieved by the fact that the following components are added to the agent based on calcium nitrate and urea: corrosion inhibitor – calcium phosphates in the amount of 0.1-0.5%, anti-caking additives – magnesium nitrate in an amount up to 6%, and urea-formaldehyde polymers in an amount up to 3%, effect-prolonging additive – calcium carbonate in an amount up to 7%.

Urea and calcium nitrate produced by any conventional method can be used as the main components of the agent.

There is a known method of producing an anti-icing agent that includes a step of evaporative concentration of a dilute calcium nitrate solution, crystallization and filtration of the calcium nitrate, the solid phase reaction of the calcium nitrate with urea with thorough mixing of the components, followed by drying of the end product [I. M. Popova, author's summary of candidate's summary dissertation "Study of the physicochemical fundamentals and technology of producing liquid and solid nitrogen fertilizers using waste products that contain calcium nitrate," Odessa, 1975].

The shortcomings of this method are its multistep nature, the difficulty of controlling the step of solid phase crystallization, the complexity of the addition and uniform distribution of

anti-corrosion and anti-caking additives, and, as a consequence, the increase of cost of the product and the [lack of] economic soundness of production.

The method proposed in this invention includes the formation of a melt of calcium nitrate, dispensing of the additives and the urea. The resulting mixture is concentrated, granulated or prilled, and then cooled. The advantage of this method is the use of a concentrated solution (melt) of calcium nitrate, which makes it possible to eliminate the step of evaporative concentration of dilute calcium nitrate solutions. In addition, the mixing of liquid reagents is a process that is easily controlled when compared to solid phase crystallization. This makes this method less energy-intensive and more technologically sound. In particular, calcium nitrate can be obtained by nitric acid decomposition of apatite, which contains as a part of its composition the corrosion inhibitor – calcium phosphates.

The composition and method of carrying out the invention are presented in examples.

Example 1. The calculated quantity of components: 38.8% calcium nitrate, 56.0% urea, 4.4% magnesium nitrate, 0.6% water, are mixed and heated until a transparent melt is obtained, and then 0.2% calcium phosphate is added to the melt and the melt is processed to form granules. The resulting granules are cooled. The product has a eutectic point of -17°C, a corrosion rate of 0.03 mm/yr, and the time for complete dissolving of granules is 20 min.

Example 2. The calculated quantity of components: 46.0% calcium nitrate, 50% urea, 3.6% magnesium nitrate, 0.4% water, are mixed, heated until a transparent melt is obtained, and processed to form granules. The resulting granules are cooled. The product has a eutectic temperature of -18°C, a corrosion rate of 0.11 mm/yr, and cakeability of 0.2 kg/cm².

Example 3. The calculating quantity of components: 40.6% calcium nitrate, 59.4% urea, is mixed, heated to form a transparent melt, and processed to form granules. The resulting granules are cooled. The product has a eutectic point of -19°C, corrosion rate of 0.12 mm/yr, cakeability of 0.4 kg/cm².

Example 4. The calculated quantity of components: 39.7% calcium nitrate, 58.0% urea, 1.0% magnesium nitrate, 0.5% water, are mixed, heated to form a transparent melt, 0.6% urea formaldehyde polymer and 0.2% calcium phosphate are added, and the mixture is processed to form granules. The resulting granules are cooled. The cakeability of the product is 0.09 kg/cm².

Example 5. The calculated quantity of components: 37.4% calcium nitrate, 0.2% calcium phosphates, 3.4% magnesium nitrate, 55.4% urea, is mixed and heated to form a transparent melt, and then 3% calcium carbonate is added to the melt and the melt is processed to form granules. The resulting granules are cooled. The product has a eutectic point of -17°C and a corrosion rate of 0.03 mm/yr. The time for complete dissolving of the granules is 40 min.

These examples are evidence that the anti-corrosion additive reduces the corrosion rate by a factor of 3 under static conditions (Examples 1 and 2), while the cakeability decreases by a

factor of 1.5 when magnesium is added and by a factor of 2-2.5 when urea formaldehyde polymer is added. The addition of calcium carbonate increases the dissolving time by a factor of 2.

Claims

1. An anti-icing agent containing calcium nitrate and urea, which is distinguished by the fact that it contains the following additives: corrosion inhibitor – calcium phosphates in an amount of 0.1-0.5 wt%, anti-caking agents – magnesium nitrate in an amount up to 6% and urea formaldehyde polymer in an amount up to 3%, effect-prolonging agent – calcium carbonate in an amount up to 7%.
2. A method of producing an anti-icing agent based on calcium nitrate and urea, which is distinguished by the fact that the additives and urea are added to a melt of calcium nitrate, the resulting mixture is concentrated to produce the composition of the reagent indicated in Claim 1, and sent to a step of granulation or prilling, followed by cooling of the end product.